

Iowa Loss Estimation Methodology and Model

The technical staff of the Iowa Homeland Security and Emergency Management Department (HSEMD) was tasked to develop the analysis and methodology to support this planning process. For the purposes of this plan, loss estimation modeling was conducted utilizing the best available information and data related to a specific hazard and applying loss estimation factors to determine future annualized losses. All hazards were looked at to determine the feasibility of determining or modeling annualized losses. It should be noted that many factors influence the feasibility of modeling losses, not the least of which relates specifically to the availability of applicable records and measurements of a particular hazards previous impacts in Iowa.

Loss estimation is a method for quantitatively valuing risk. Loss estimation approaches generally require a tremendous amount of data and information in order to generate a valued result. Therefore, valuation tends to be less sensitive to judgment and parametric changes than more qualitative risk assessments.

The spatial and financial context of loss estimates is useful for mitigation, planning and prevention related tasks such as regulating land use, establishing building standards and community planning.

Describing vulnerability in terms of dollar losses is a useful tool providing the state a common framework to measure the potential effects of specific hazards. This can also provide a measurable baseline that can be used to measure the effectiveness of risk reduction measures. State facilities are included in this process and ideally this process would progress to provide for a more detailed analysis of all government and privately held assets, facilities, structures and services, and examining the potential risk created by each individual hazard.

It remains a fact that not all natural and manmade hazards can be modeled for annualized losses as a part of the hazard analysis and risk assessment process. Challenges remain to similarly quantify manmade and technological hazards and associated risks in an effort to better understand and

comparatively measure each. However, progress will continue to be made in an effort to collect and analyze additional studies and information to address loss associated with all 20 natural and human caused disasters in future updates of the Iowa Hazard Mitigation Plan. Currently, the hazards to be addressed in the future include: levee/dam failure, terrorism, animal/plant/crop disease, HAZMAT incident, radiological incident, human disease, transportation incident, infrastructure failure, sinkholes, landslides, earthquake, and expansive soils.

Iowa's inclusion of loss estimation in this plan provides for an estimate of annual losses for eight hazards in which data was available and could be referenced geographically. Those eight hazards modeled are:

- Flooding
- Severe Winter Storm
- Drought
- Tornado/Windstorm
- Hail/Lightning/Thunderstorm
- Flash Flood
- Wildfire
- Extreme Heat

The 8 hazards modeled were dependent upon consistent and available historical data to set the parameters of the analysis and to drive the applied factors used to model the losses associated with the hazard. The following table shows the breakdown for the eight hazards analyzed with annualized dollar values in millions.

Iowa	Flood	Tornado	Winter Storm	Flash Flood
Hazard Total	\$ 955.858	\$ 36.249	\$ 2.250	\$ 13.480
Hail*	Drought	Ex. Heat	Wildfire	Total
\$ 30.455	\$ 424.833	\$ 1.789	\$ 0.144	\$ 1,465.058

*Hail figure also includes lightning damage and is representative of Thunderstorm/Lightning/Hail hazard identified in the Risk Assessment

Established Parameters Guiding Loss Estimation Model for Iowa

The results of the loss estimation model were formulated at the statewide, regional and countywide level. The resulting loss estimates were developed and broken into categories or types of damage whenever the data available allowed. The specific loss numbers as reported by the National Climatic Data Center have been separated and/or averaged by county when specific events were reported across county jurisdictions to avoid loss figures and fatalities/injuries from being counted multiple times.

Flooding Loss Estimation Methodology

Statewide annual damage parameters were established utilizing the National Climatic Data Center Data. Factors were developed specific to the attributes of each county and these factors were applied to produce annual flood loss estimation for each of Iowa's 99 counties:

Factors:

- Years with Recorded Loss
- Statewide Total Flood Damage History (DH)

$$\text{Total Flood Damage History (DH) / Number of Years of Recorded Loss (20 years) = Average Annual Countywide Flood Loss Estimate (FLE)}$$

Drought Loss Estimation Methodology

Statewide annual damage parameters were established utilizing the NCDC Data Base. Factors were developed specific to the attributes of the drought hazard in each county and the specific physical attributes of each county to produce the annual drought loss estimation for each of Iowa's 99 counties:

Factors:

- 18 Year Drought Record for County (TR)
- Statewide Annual Drought Damage History (DH)

$$\text{Total Drought Damage History (DH) / Number of Years of Recorded Loss (18 years) = Average Annual Countywide Drought Loss Estimate (DLE)}$$

The DLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide DLE that in turn was validated against the DH. Each county DLE was then validated comparatively utilizing historical data from the NCDC Data Base as well as historical damage data from the Federal Emergency Management Agency (FEMA) Public Assistance (PA) Program.

Tornado/Windstorm Loss Estimation Methodology

The previous version of the plan had separate loss estimations for Windstorm and Tornado hazards. Windstorm is no longer an event type in the NCDC, so it was eliminated. To retain a longer historical collection of tornado events loss estimation for Tornado/Windstorm used the tornado data. Statewide annual damage parameters were established utilizing the NCDC Data Base. Factors were developed specific to the attributes of the tornado hazard in each county and the specific physical attributes of each county to produce the annual tornado loss estimation for each of Iowa's 99 counties:

Factors:

- 63 Year Tornado Record for County (WR)
- Statewide Annual Tornado Damage History (DH)

$$\text{Total Tornado Damage History (DH) / Number of Years of Recorded Loss (63 years) = Average Annual Countywide Tornado Loss Estimate (TLE)}$$

The TLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide TLE that in turn was validated against

the DH. Each county TLE was then validated comparatively utilizing historical data from the NCDC Data Base.

Hail/Lightning/Thunderstorm Loss Estimation Methodology

Hail and Lightning were compiled separately and combined for loss estimation of the Thunderstorm/Lightning/Hail hazard. The NCDC event thunderstorm is no longer available, so the combined hail and lightning represent the losses associated with this hazard. Statewide annual damage parameters were established utilizing the NCDC Data Base. Factors were developed specific to the attributes of the hail/lightning hazard in each county and the specific physical attributes of each county to produce the annual hailstorm loss estimation for each of Iowa's 99 counties:

Factors:

- 17 Year Hail/Lightning Record for County (WR)
- Statewide Annual Hail/Lightning Damage History (DH)

$$\text{Total Hail/Lightning Damage History (DH) / Number of Years of Recorded Loss (17 years) = Average Annual Countywide Hail/Lightning Loss Estimate (HLE)}$$

The HLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide WLE that in turn was validated against the DH. Each county HLE was then validated comparatively utilizing historical data from the NCDC Data Base.

Severe Winter Storm Loss Estimation Methodology

Statewide annual damage parameters were established utilizing the NCDC Data Base. Winter storm event type was substituted for previous extreme cold, snow, and ice. Factors were developed specific to the attributes of the Winter Storm hazard in each county and the specific physical attributes of each county to produce the annual Winter Storm loss estimation for each of Iowa's 99 counties:

Factors:

- 13 Year Extreme Cold Record for County (WR)
- Statewide Annual Winter Storm Damage History (DH)

$$\text{Total Winter Storm Damage History (DH) / Number of Years of Recorded Loss (13 years) = Average Annual Countywide Winter Storm Loss Estimate (WSLE)}$$

The WSLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide WSLE that in turn was validated against the DH. Each county WSLE was then validated comparatively utilizing historical data from the NCDC Data Base.

Flash Flood Loss Estimation Methodology

Statewide annual damage parameters were established utilizing the NCDC Data Base. Factors were developed specific to the attributes of the Flash Flood hazard in each county and the specific physical attributes of each county to produce the annual flash flood loss estimation for each of Iowa's 99 counties:

Factors:

- 13 Year Flash Flood Record for County (WR)
- Statewide Annual Flash Flood Damage History (DH)

$$\text{Total Flash Flood Damage History (DH) / Number of Years of Recorded Loss (16 years) = Average Annual Countywide Flash Flood Loss Estimate (FFLE)}$$

The FFLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide FFLE that in turn was validated against the DH. Each county FFLE was then validated comparatively utilizing historical data from the NCDC Data Base.

Wildfire Loss Estimation Methodology

Statewide annual damage parameters were established utilizing the NCDC Data Base. Factors were developed specific to the attributes of the wildfire hazard in each county and the specific physical attributes of each county to produce the annual windstorm loss estimation for each of Iowa’s 99 counties:

Factors:

- 8 Year Windstorm Record for County (WR)
- Statewide Annual Wildfire Damage History (DH)

$$\text{Total Wildfire Damage History (DH) / Number of Years of Recorded Loss (8 years) = Average Annual Countywide Wildfire Loss Estimate (WFLE)}$$

The WFLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide WFLE that in turn was validated against the DH. Each county WFLE was then validated comparatively utilizing historical data from the NCDC Data Base.

Excessive Heat Loss Estimation Methodology

Statewide annual damage parameters were established utilizing the NCDC Data Base. Excessive heat replaced extreme heat as the event type in the NCDC. Factors were developed specific to the attributes of the excessive heat hazard in each county and the specific physical attributes of each county to produce the annual extreme heat loss estimation for each of Iowa’s 99 counties:

Factors:

- 4 Year Extreme Heat Record for County (WR)
- Statewide Annual Extreme Heat Damage History (DH)

$$\text{Total Extreme Heat Damage History (DH) / Number of Years of Recorded Loss (4 years) = Average Annual Countywide Extreme Heat Loss Estimate (EHLE)}$$

The EHLE for each county was calculated then summed for all 99 Iowa counties. This calculated a statewide EHLE that in turn was validated against the DH. Each county EHLE was then validated comparatively utilizing historical data from the NCDC Data Base.

The tables on the following pages include metadata by hazard evaluated.

Hazard	Data Sources	Data Products	Data Source Comments
Flooding	United State Army Corp of Engineers (USACE), National Weather Service (NWS), National Climatic Data Center(NCDC), Federal Emergency Management Agency(FEMA), United States Census Bureau, Iowa HSEMD	USACE and NWS Annual Flood Damage Reduction Report to Congress. NCDC Data base, FEMA Community Status Book, FEMA National Flood Insurance Program (NFIP) Repetitive Loss Report, United States Census Bureau 2010 Census	The 1955-1975 flood damage figures for the 50 states were compiled from Climatological Data National Summary, Annual Summary (CDNS) 27(13): 124. The 1983-1999 flood damage figures for the 50 states, Puerto Rico, and the Virgin Islands were compiled from the 1992 and 1999 U.S. Army Corps of Engineers Annual Flood Damage Report to Congress . Data for 1976-1982 are not deemed reliable at the state level to include in the analyses. Damage figures were originally reported in hydrologic years and, beginning in 1983, were reported in fiscal years. Note that flood damage was reported as "zero" in the 1983-1990 reports if damage figures were unavailable, even though flooding occurred. Data in this project are the result of an ongoing reanalysis of the nation's flood damage data record, sponsored by the Office of Global Programs of the National Oceanic and Atmospheric Administration. Adjustments: The flood damage data have been adjusted for inflation and wealth using the same methodology used with tornado damages. Data from 2010-2013 drought damage figures for the 50 states and Territories were compiled from the

Hazard	Data Sources	Data Products	Data Source Comments
			<u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC).
Drought	National Weather Service (NWS), National Climatic Data Center(NCDC), Federal Emergency Management Agency(FEMA), United States Census Bureau, Iowa HSEMD	NCDC Data base, United States Census Bureau 2010 Census	The 1993 - 2013 drought damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database contains all weather events from 1993 to the present, as entered into the <u>Storm Data publication</u> . The damage amounts are estimates by the National Weather Service at the time of the report.
Flash Flood	United States Department of Agriculture (USDA) Risk Management Agency (RMA), Federal Emergency Management Agency(FEMA), United States Census Bureau, Iowa HSEMD	NCDC Data base, United States Census Bureau 2010 Census	The 2000 - 2013 Flash Flood damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database contains all weather events from 1993 to the present, as entered into the <u>Storm Data publication</u> . The damage amounts are estimates by the National Weather Service at the time of the report.
Tornado	National Weather Service (NWS), National Climatic Data Center(NCDC), Federal Emergency Management Agency(FEMA), United States	NCDC Data base, United States Census Bureau 2010 Census	The 1950 - 2013 tornado damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database contains all weather events from 1993 to the present, as entered

Hazard	Data Sources	Data Products	Data Source Comments
	Census Bureau, Iowa HSEMD		into the <u>Storm Data publication</u> , as well as tornado data from 1950 through 1992 from the Storm Prediction Center. The Storm Events database was derived from the " <u>Pearson Tornado Tape database</u> " (item 9714). The damage amounts are estimates by the National Weather Service at the time of the report.
Hail / Lightning	National Weather Service (NWS), National Climatic Data Center (NCDC), Federal Emergency Management Agency (FEMA), Iowa HSEMD	NCDC Data base, United States Census Bureau 2010 Census	The 1996 - 2013 hail/lightning damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database contains all weather events from 1993 to the present, as entered into the <u>Storm Data publication</u> . The damage amounts are estimates by the National Weather Service at the time of the report.
Winter Storm	National Weather Service (NWS), National Climatic Data Center (NCDC), Federal Emergency Management Agency (FEMA), United States Census Bureau, Iowa HSEMD	NCDC Data base, United States Census Bureau 2010 Census	The 2000 - 2013 winter storm damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database contains all weather events from 1993 to the present, as entered into the <u>Storm Data publication</u> . The damage amounts are estimates by the National Weather Service at the time of the report.
Wildfire	National Weather Service (NWS), National Climatic Data Center (NCDC), Federal Emergency Management	NCDC Data base, United States Census Bureau 2010 Census	The 2005 - 2013 wildfire damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database

Hazard	Data Sources	Data Products	Data Source Comments
	Agency (FEMA), United States Census Bureau, Iowa HSEMD		contains all weather events from 1993 to the present, as entered into the <u>Storm Data publication</u> . The damage amounts are estimates by the National Weather Service at the time of the report.
Excessive Heat	National Weather Service (NWS), National Climatic Data Center (NCDC), Federal Emergency Management Agency (FEMA), United States Census Bureau, Iowa HSEMD	NCDC Data base, United States Census Bureau 2010 Census	The 2009 - 2013 snow & ice damage figures for the 50 states and Territories were compiled from the <u>Storm Events database</u> maintained by the National Climatic Data Center (NCDC). The Storm Events database contains all weather events from 1993 to the present, as entered into the <u>Storm Data publication</u> . The damage amounts are estimates by the National Weather Service at the time of the report.